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Testing of

Electromagnetic Emissions

per

USA: CFR Title 47, Part 15.247
Canada: IC RSS-210/GENe

are herein reported for

Danlaw Inc.
DL815

Test Report No.: 20150421-TRPDANL10001r1

Applicant/Provider:
Danlaw Inc.
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Measured by:	Dr. Joseph Brunett, EMC-002790-NE	Report Approved by:	Dr. Joseph Brunett, EMC-002790-NE
Report by:	Dr. Joseph Brunett, EMC-002790-NE	Report Date of Issue:	April 21, 2015

Results of testing completed on (or before) April 16, 2015 are as follows.

Emissions: The transmitter intentional emissions **COMPLY** with the regulatory limit(s) by no less than 17.7 dB. Transmit chain spurious harmonic emissions **COMPLY** by no less than 2.1 dB. Radiated spurious emissions associated with the receive chain of this device **COMPLY** the regulatory limit(s) by no less than 15.0 dB.

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1 Test Specifications, General Procedures, and Location

1.1 Test Specification and General Procedures

The ultimate goal of Danlaw Inc. is to demonstrate that the Equipment Under Test (EUT) complies with the Rules and/or Directives below. Detailed in this report are the results of testing the Danlaw Inc. DL815 for compliance to:

Country/Region	Rules or Directive	Referenced Section(s)
United States	Code of Federal Regulations	CFR Title 47, Part 15.247
Canada	Industry Canada	IC RSS-210/GENe

Danlaw Inc. has determined that the equipment under test is subject to the rules and directives above at the date of this testing. In conjunction with these rules and directives, the following specifications and procedures are followed herein to demonstrate compliance (in whole or in part) with these regulations.

ANSI C63.4:2009	"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
FCC-KDB 558074 v03r02-2014	"Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247"
FCC-KDB 913591 2007	"Measurement of radiated emissions at the edge of the band for a Part 15 RF Device"
Industry Canada	"The Measurement of Occupied Bandwidth"

1.2 Test Location and Equipment Used

Test Location The EUT was fully tested by **Willow Run Test Labs, LLC**, 8501 Beck Road, Building 2227, Belleville, Michigan 48111 USA. The Test Facility description and attenuation characteristics are on file with the FCC Laboratory, Columbia, Maryland (FCC Reg. No: 688478) and with Industry Canada, Ottawa, ON (File Ref. No: IC 8719A-1).

Test Equipment Pertinent test equipment used for measurements at this facility is listed in Table 1. The quality system employed at Willow Run Test Labs, LLC has been established to ensure all equipment has a clearly identifiable classification, calibration expiry date, and that all calibrations are traceable to the SI through NIST, other recognized national laboratories, accepted fundamental or natural physical constants, ratio type of calibration, or by comparison to consensus standards.

Table 1: Willow Run Test Labs, LLC Equipment List

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Description	**Manufacturer/Model**	**SN**	**Quality Num.**	**Last Cal By / Date Due**
Spectrum Analyzer	Rhode-Schwarz / FSV30	101660	RSFSV30001	RS / Apr-2016
Dipole Set (20-1000 MHz)	EMCO / 3121C	9504-1121	DIPEMC001	Liberty Labs / Sep-2016
Ridge-Horn Antenna	Univ. of Michigan / VVL	5	UMHORN005	UMRL / Jul-2015
LS-Band Horn	JEF / NRL Std.	001	HRN15001	WRTL / Jul-2015
S-Band Horn	SA / NRL Std.	1854	HRNS001	WRTL / Jul-2015
C-Band Horn	SA / NRL Std.	-	HRNC001	WRTL / Jul-2015
XN-Band Horn	JEF / NRL Std.	001	HRNXN001	WRTL / Jul-2015
X-Band Horn	JEF / NRL Std.	001	HRNX001	WRTL / Jul-2015
KU-Band Horn	JEF / NRL Std.	001	HRNKU001	WRTL / Jul-2015
K-Band Horn	JEF / NRL Std.	001	HRNK001	WRTL / Jul-2015

2 Configuration and Identification of the Equipment Under Test

2.1 Description and Declarations

The EUT is a vehicular Bluetooth DTS transceiver. The EUT is approximately 45 x 48 x 23 mm in dimension, and is depicted in Figure 1. It is powered by a 13.4 VDC vehicular power system. This device is a wireless Bluetooth communication device for monitoring and logging vehicle network message data. Table 2 outlines provider declared EUT specifications.

Figure 1: Photos of EUT.

Table 2: EUT Declarations.

General Declarations			
Equipment Type:	Bluetooth DTS Transceiver	**Country of Origin:**	USA
Nominal Supply:	13.4 VDC	**Oper. Temp Range:**	Not Declared
Frequency Range:	2402 – 2480 MHz	**Antenna Dimension:**	Not Declared
Antenna Type:	Integral	**Antenna Gain:**	Not Declared
Number of Channels:	79	**Channel Spacing:**	1 MHz
Alignment Range:	Not Declared	**Type of Modulation:**	GFSK pi/4-DQPSK 8DPSK LE
United States			
FCC ID Number:	2AD9I-DL815	**Classification:**	DTS
Canada			
IC Number:	20087-DL815	**Classification:**	Spread Spectrum, Bluetooth

2.1.1 EUT Configuration

The EUT is configured for testing as depicted in Figure 2.

2.1.2 Modes of Operation

As a Bluetooth 4.0+LE device, the EUT is capable of operation as a transceiver employing GFSK, pi/4-DPSK, 8DPSK modulations and LE modulations. Test samples were placed into worst-case operating modes using the manufacture's supplied custom software interface (via auxillary PC) and/or our Agilent N4010A Bluetooth test set. Please note that the different operating modes (data-mode, acquisition-mode) of a Bluetooth device do not influence the channel spacing or peak output power. There is only one transmitter which is driven by identical input parameters concerning these values.

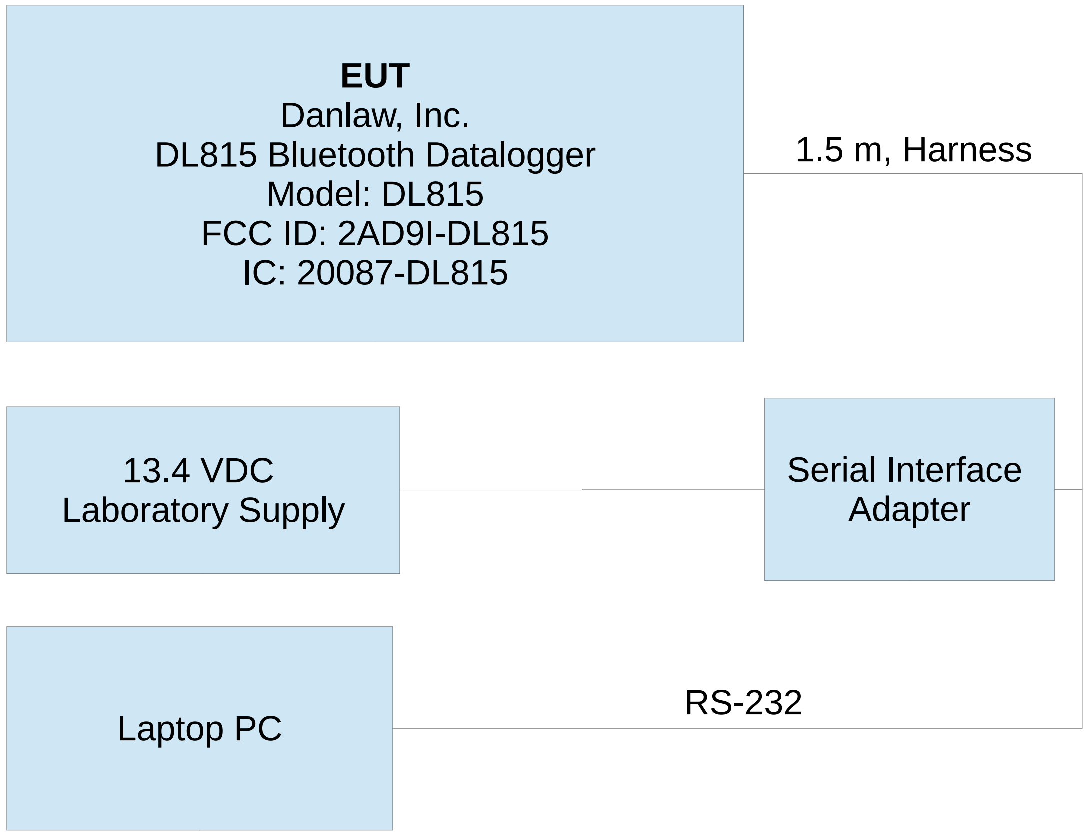


Figure 2: EUT Test Configuration Diagram.

2.1.3 Variants

There is only a single variant of the EUT. Test samples were programmed into worst case on time, worst case emission bandwidth, and CW mode using a supplied PC interface.

2.1.4 Test Samples

Three samples in total were provided. A normal sample and a sample modified with an RF coaxial cable attached to the Bluetooth radio were provided, both capable of direct programming via a test PC interface. A third unmodified sample was provided for photographs.

2.1.5 Functional Exerciser

Normal operating EUT functionality was verified by observation of transmitted signal.

2.1.6 Modifications Made

There were no modifications made to the EUT by this laboratory.

2.1.7 Production Intent

The EUT appears to be a production ready sample.

2.1.8 Declared Exemptions and Additional Product Notes

The EUT is permanently installed in a transportation vehicle. As such, digital emissions are exempt from US and Canadian digital emissions regulations (per FCC 15.103(a) and IC correspondence on ICES-003).

3 Emissions

3.1 General Test Procedures

3.1.1 Radiated Test Setup and Procedures

Radiated electromagnetic emissions from the EUT are first pre-scanned in our shielded anechoic chamber. Spectrum and modulation characteristics of all emissions are recorded. Instrumentation, including spectrum analyzers and other test equipment as detailed in Section 1.2 are employed. After indoor pre-scans, emission measurements are made on our outdoor 3-meter Open Area Test Site (OATS). If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in relevant test standards are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed if the resulting emissions appear to be worst-case in such a configuration. See Figure 3. All intentionally radiating elements that are not fixed-mounted in use are placed on the test table lying flat, on their side, and on their end (3-axes) and the resulting worst case emissions are recorded. If the EUT is fixed-mounted in use, measurements are made with the device oriented in the manner consistent with installation and then emissions are recorded.

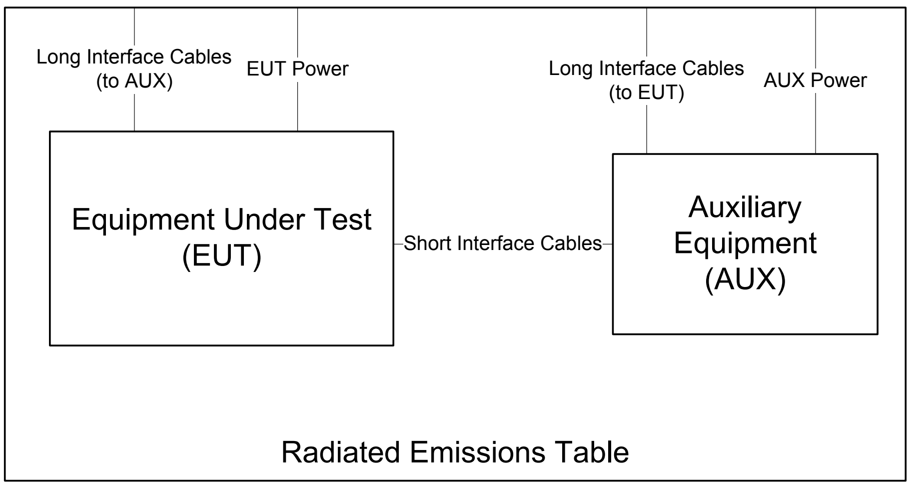


Figure 3: Radiated Emissions Diagram of the EUT.

If the EUT exhibits spurious emissions due to internal receiver circuitry, such emissions are measured with an appropriate carrier signal applied. For devices with intentional emissions below 30 MHz, a shielded loop antenna is used. It is placed at a 1 meter receive height. Emissions between 30 MHz and 1 GHz are measured using tuned dipoles and/or calibrated broadband antennas. For both horizontal and vertical polarizations, the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected. The EUT is then rotated through 360^o in azimuth until the highest emission is detected. The test antenna is then raised and lowered one last time from 1 to 4 m and the worst case value is recorded. Emissions above 1 GHz are characterized using standard gain horn antennas or calibrated broadband ridge-horn antennas on our OATS with a 2.4m x 2.4m square of AN-79 or H-4 absorber placed over the ground screen between the EUT and the test antenna. Care is taken to ensure that test receiver resolution and video bandwidths meet the regulatory requirements, and that the emission bandwidth of the EUT is not reduced. Photographs of the test setup employed are depicted in Figure 4.

Where regulations allow for direct measurement of field strength, power values (dBm) measured on the test receiver / analyzer are converted to dBμV/m at the regulatory distance, using

$$E_{dist} = 107 + P_R + K_A - K_G + K_E - C_F$$

where P_R is the power recorded on spectrum analyzer, in dBm, K_A is the test antenna factor in dB/m, K_G is the combined pre-amplifier gain and cable loss in dB, K_E is duty correction factor (when applicable) in dB, and C_F is a distance conversion (employed only if limits are specified at alternate distance) in dB. This field strength value is then compared with the regulatory limit. If effective isotropic radiated power (EIRP) is computed, it is computed as

$$EIRP(dBm) = E_{3m}(dB\mu V/m) - 95.2.$$

When presenting data at each frequency, the highest measured emission under all possible EUT orientations (3-axes) is reported.

Figure 4: Radiated Emissions Test Setup Photograph(s).

3.1.2 Conducted Emissions Test Setup and Procedures

Transmit Antenna Port Conducted Emissions At least one sample EUT supplied for testing was provided with a 50Ω antenna port. Conducted transmit chain emissions measurements (where applicable) are made by connecting the EUT antenna port directly to the test receiver port. Photographs of the test setup employed are depicted in Figure 5.

Figure 5: Conducted RF Test Setup Photograph(s).

Vehicle Power Conducted Spurious The EUT is not subject to power line conducted emissions regulations as it is powered solely by the vehicle power system for use in said motor vehicle.

3.1.3 Power Supply Variation

Tests at extreme supply voltages are made if required by the the procedures specified in the test standard, and results of this testing are detailed in this report.

3.1.4 Thermal Variation

Tests at extreme temperatures are made if required by the procedures specified in the test standard, and results of this testing are detailed in this report. The provider has declared that the EUT is designed for operation over the temperature range Not Declared. Before any temperature measurements are made, the equipment is allowed to reach a thermal balance in the test chamber, temperature and humidity are recorded, and thermal balance is verified via a thermocouple based probe.

3.2 Intentional Emissions

3.2.1 Duty and Transmission Cycle, Pulsed Operation

The details and results of testing the EUT for pulsed operation are summarized in Table 3.

Table 3: Pulsed Emission Characteristics (Duty Cycle).

Frequency Range	Det	IFBW	VBW		
f > 1 000 MHz	Pk	3 MHz	5 MHz	**Test Date:**	12-Apr-15
				Test Engineer:	Joseph Brunett
				EUT	Danlaw DL815
				Meas. Distance:	Conducted

Pulsed Operation / Duty Cycle

Transmit Mode	Symbol Rate (Msym/s)	Data Rate (Mbps)	Voltage (V)	Oper. Freq (MHz)	Tx Cycle Time* (ms)	On-Time* (ms)	Duty Cycle (%)	Power Duty Correction (dB)
Hopping	1.000	GFSK (1 Mbps)	13.4	2441.0	-	-	-	20.0
	1.000	Pi/4 DPSK (2 Mbps)	13.4	2441.0	-	-	-	20.0
	1.000	8DPSK (3 Mbps)	13.4	2441.0	-	-	-	20.0
LE (Cont Modulated)	-	-	13.4	2441.0	-	-	100.0	0.0

(1) For a FHSS Bluetooth transmitter the peak to average ratio in any given 100 ms window is always less than 10%. Thus, maximum permitted 15.35 duty of 20 dB is applied to peak measurements for demonstrating average field strength compliance, were applicable. For BLE, 100% continuous on-time transmission was employed using the manufacturers software interface. Thus, no duty cycle is applied in demonstrating compliance.

Equipment Used: RSFSV30001

3.2.2 Fundamental Emission Bandwidth

Emission bandwidth (EBW) of the EUT is measured with the device placed in the test mode(s) with the shortest available packet length and minimum packet spacing. Radiated emissions are recorded following the test procedures listed in Section 1.1. The 6 dB bandwidth is measured for the lowest, middle, and highest channels available. The 99% emission bandwidth per IC test procedures is also reported.The results of this testing are summarized in Table 4. Plots showing measurements employed obtain the emission bandwidths reported are provided in Figure 6.

Table 4: Intentional Emission Bandwidth.

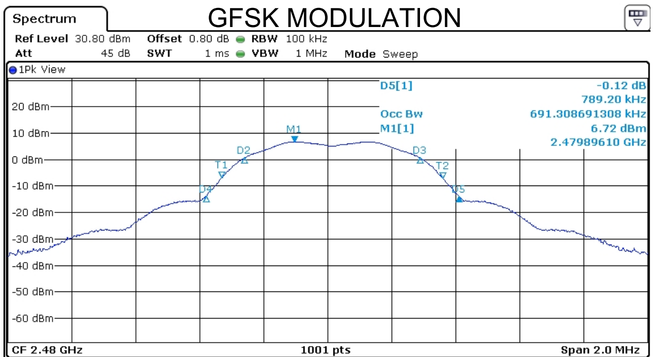
Frequency Range	Det	IFBW	VBW
f > 1 000 MHz	Pk	100 kHz	300 kHz
f > 1 000 MHz	Pk	100 kHz	300 kHz

Test Date:	05/06/15
Test Engineer:	Joseph Brunett
EUT	Danlaw DL815
Meas. Distance:	Conducted

Occupied Bandwidth									
Transmit Mode	Symbol Rate (Msym/s)	Data Rate* (Mbps)	Voltage (V)	Oper. Freq (MHz)	6 dB BW (MHz)	6 dB BW Limit (MHz)	99% OBW (MHz)	20 dB BW (MHz)	Pass/Fail
GFSK	1	1.0	13.4	2402.0	0.523	0.500	0.657	0.755	Pass
				2441.0	0.544	0.500	0.673	0.765	Pass
				2480.0	0.548	0.500	0.691	0.789	Pass
PI/4 DQPSK	1	2.0	13.4	2402.0	1.103	0.500	1.247	1.445	Pass
				2441.0	1.112	0.500	1.259	1.448	Pass
				2480.0	1.105	0.500	1.256	1.428	Pass
8QPSK	1	3.0	13.4	2402.0	1.100	0.500	1.253	1.430	Pass
				2441.0	1.115	0.500	1.253	1.430	Pass
				2480.0	1.229	0.500	1.259	1.434	Pass
LE	-	-	13.4	2402.0	0.692	0.500	1.040	1.223	Pass
				2441.0	0.692	0.500	1.043	1.229	Pass
				2480.0	0.688	0.500	1.040	1.215	Pass

* Over all modes of operation, the worst case (highest data rate) in each form of modulation was tested to demonstrate compliance. For GFSK, worst test pattern employed F0F0 dataset, for pi/4-DQPSK the PN15 dataset, for 8-DQPSK the PN15 dataset, and for LE the PN15 dataset.

Equipment Used: RSFSV30001



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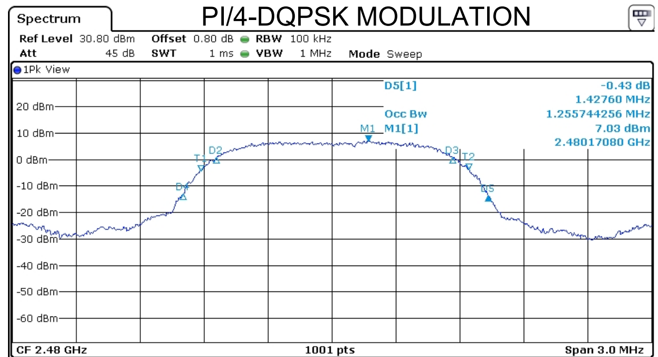
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4798961 GHz	6.72 dBm		
T1		1	2.47966833 GHz	-6.89 dBm	Occ Bw	691.308691308 kHz
T2		1	2.48035964 GHz	-6.99 dBm		
D2	M1	1	-155.8 kHz	-6.01 dB		
D3	D2	1	547.5 kHz	0.05 dB		
D4	M1	1	-275.7 kHz	-20.55 dB		
D5	D4	1	789.2 kHz	-0.12 dB		



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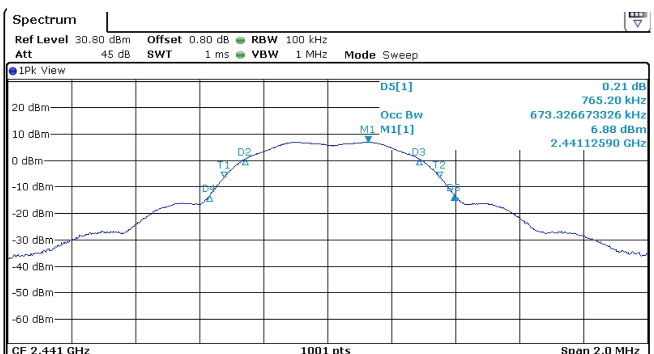
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4801708 GHz	7.03 dBm		
T1		1	2.47938561 GHz	-4.22 dBm	Occ Bw	1.255744256 MHz
T2		1	2.48064136 GHz	-3.74 dBm		
D2	M1	1	-712.3 kHz	-6.12 dB		
D3	D2	1	1.1049 MHz	-0.09 dB		
D4	M1	1	-868.1 kHz	-20.02 dB		
D5	D4	1	1.4276 MHz	-0.43 dB		



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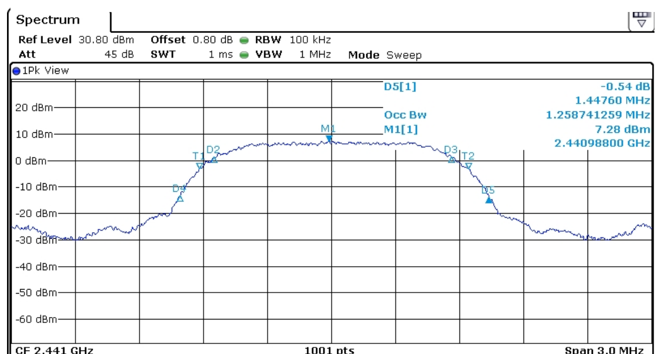
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411259 GHz	6.88 dBm		
T1		1	2.44067632 GHz	-6.42 dBm	Occ Bw	673.326673326 kHz
T2		1	2.44134965 GHz	-6.45 dBm		
D2	M1	1	-383.6 kHz	-6.27 dB		
D3	D2	1	543.5 kHz	-0.05 dB		
D4	M1	1	-495.5 kHz	-20.16 dB		
D5	D4	1	765.2 kHz	0.21 dB		



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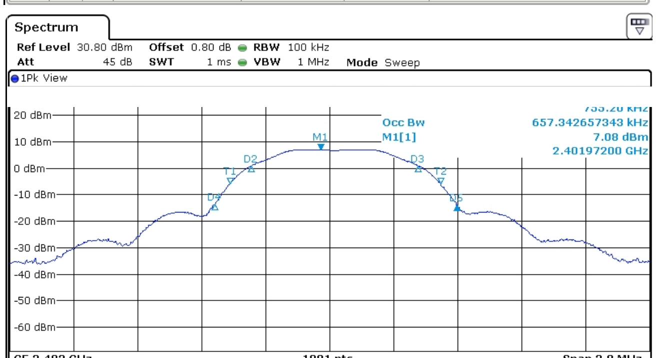
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.440988 GHz	7.28 dBm		
T1		1	2.44038262 GHz	-3.21 dBm	Occ Bw	1.258741259 MHz
T2		1	2.44164136 GHz	-3.12 dBm		
D2	M1	1	-539.5 kHz	-5.97 dB		
D3	D2	1	1.1119 MHz	-0.00 dB		
D4	M1	1	-698.3 kHz	-20.45 dB		
D5	D4	1	1.4476 MHz	-0.54 dB		



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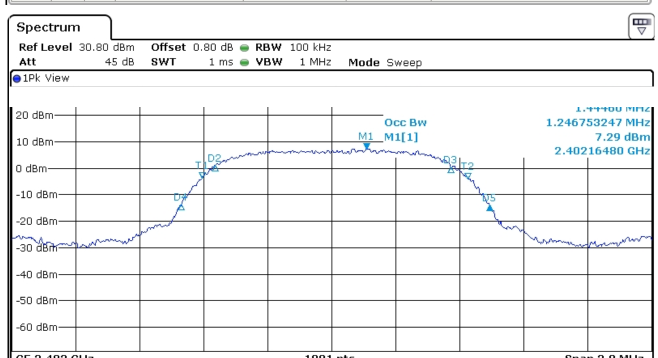
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401972 GHz	7.08 dBm		
T1		1	2.40168831 GHz	-5.87 dBm	Occ Bw	657.342657343 kHz
T2		1	2.40234565 GHz	-5.95 dBm		
D2	M1	1	-218.0 kHz	-6.14 dB		
D3	D2	1	522.7 kHz	-0.01 dB		
D4	M1	1	-331.2 kHz	-20.70 dB		
D5	D4	1	755.2 kHz	-0.14 dB		



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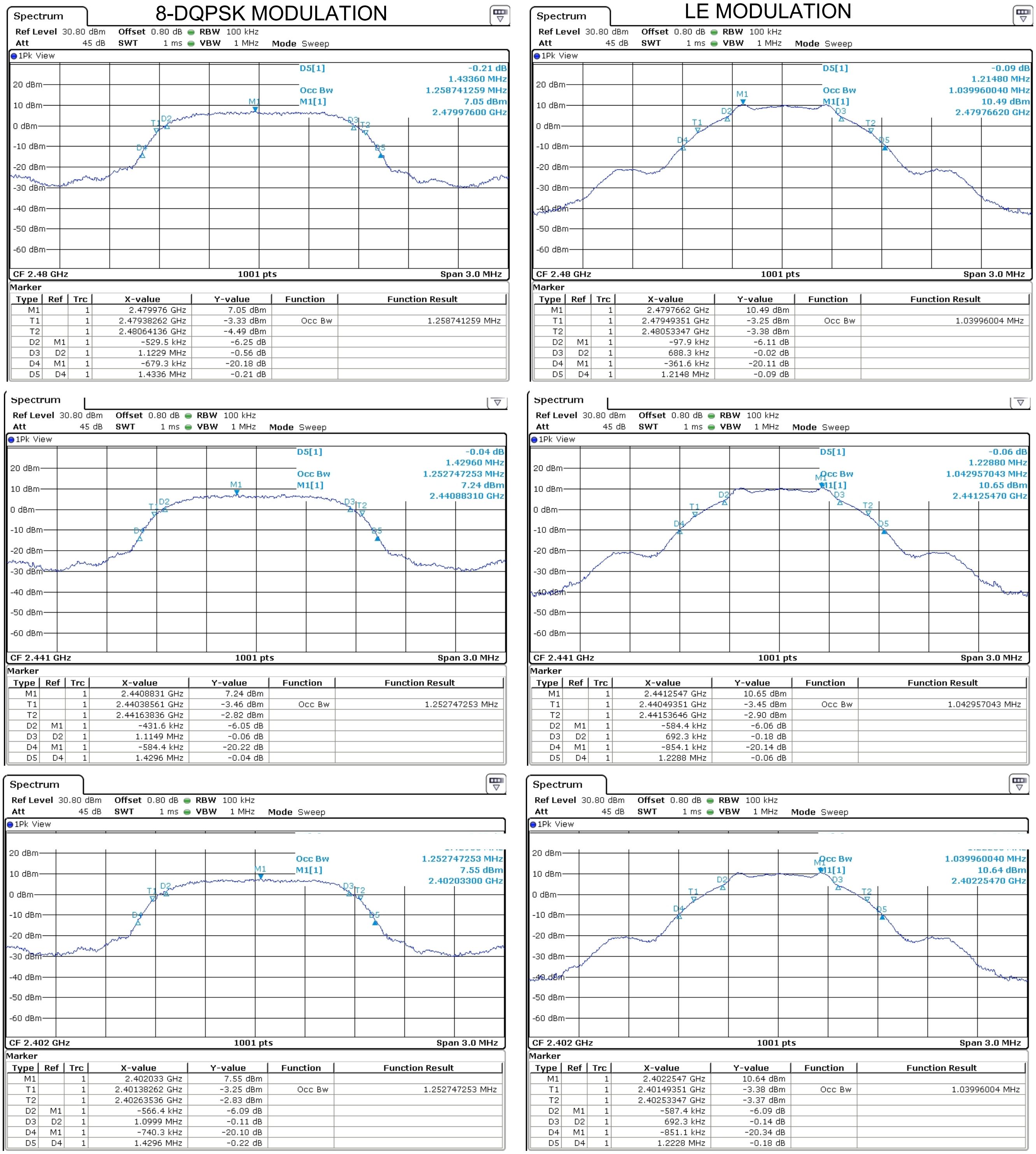
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021648 GHz	7.29 dBm		
T1		1	2.40139161 GHz	-3.74 dBm	Occ Bw	1.246753247 MHz
T2		1	2.40263836 GHz	-4.06 dBm		
D2	M1	1	-710.3 kHz	-6.09 dB		
D3	D2	1	1.1029 MHz	-0.58 dB		
D4	M1	1	-869.1 kHz	-20.71 dB		
D5	D4	1	1.4446 MHz	-0.44 dB		

Figure 6(a): Intentional Emission Bandwidth.



8-DQPSK MODULATION, CF 2.48 GHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479976 GHz	7.05 dBm		
T1		1	2.47938262 GHz	-3.33 dBm	Occ Bw	1.258741259 MHz
T2		1	2.48064136 GHz	-4.49 dBm		
D2	M1	1	-529.5 kHz	-6.25 dB		
D3	D2	1	1.1229 MHz	-0.56 dB		
D4	M1	1	-679.3 kHz	-20.18 dB		
D5	D4	1	1.4336 MHz	-0.21 dB		

LE MODULATION, CF 2.48 GHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4797662 GHz	10.49 dBm		
T1		1	2.47949351 GHz	-3.25 dBm	Occ Bw	1.03996004 MHz
T2		1	2.48053347 GHz	-3.38 dBm		
D2	M1	1	-97.9 kHz	-6.11 dB		
D3	D2	1	688.3 kHz	-0.02 dB		
D4	M1	1	-361.6 kHz	-20.11 dB		
D5	D4	1	1.2148 MHz	-0.09 dB		

8-DQPSK MODULATION, CF 2.441 GHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4408831 GHz	7.24 dBm		
T1		1	2.44038561 GHz	-3.46 dBm	Occ Bw	1.252747253 MHz
T2		1	2.44163836 GHz	-2.82 dBm		
D2	M1	1	-431.6 kHz	-6.05 dB		
D3	D2	1	1.1149 MHz	-0.06 dB		
D4	M1	1	-584.4 kHz	-20.22 dB		
D5	D4	1	1.4296 MHz	-0.04 dB		

LE MODULATION, CF 2.441 GHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4412547 GHz	10.65 dBm		
T1		1	2.44049351 GHz	-3.45 dBm	Occ Bw	1.042957043 MHz
T2		1	2.44153646 GHz	-2.90 dBm		
D2	M1	1	-584.4 kHz	-6.06 dB		
D3	D2	1	692.3 kHz	-0.18 dB		
D4	M1	1	-854.1 kHz	-20.14 dB		
D5	D4	1	1.2288 MHz	-0.06 dB		

8-DQPSK MODULATION, CF 2.402 GHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.402033 GHz	7.55 dBm		
T1		1	2.40138262 GHz	-3.25 dBm	Occ Bw	1.252747253 MHz
T2		1	2.40263536 GHz	-2.83 dBm		
D2	M1	1	-566.4 kHz	-6.09 dB		
D3	D2	1	1.0999 MHz	-0.11 dB		
D4	M1	1	-740.3 kHz	-20.10 dB		
D5	D4	1	1.4296 MHz	-0.22 dB		

LE MODULATION, CF 2.402 GHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4022547 GHz	10.64 dBm		
T1		1	2.40149351 GHz	-3.38 dBm	Occ Bw	1.03996004 MHz
T2		1	2.40253347 GHz	-3.37 dBm		
D2	M1	1	-587.4 kHz	-6.09 dB		
D3	D2	1	692.3 kHz	-0.14 dB		
D4	M1	1	-851.1 kHz	-20.34 dB		
D5	D4	1	1.2228 MHz	-0.18 dB		

Figure 6(b): Intentional Emission Bandwidth.

3.2.3 Effective Isotropic Radiated Power

The EUT's radiated power is computed from antenna port conducted power measurements and the gain of the EUT antenna(s). Where the EUT is not sold with an antenna connector, a modified product has been provided including such. Peak conducted output power was measured directly from the EUT at the port where the antenna attaches. The test receiver bandwidth was set to be greater than the measured emission bandwidth of the EUT to capture the true peak. Antenna gain is either provided directly by the antenna manufacturer or measured by comparison between substitution based EIRP and conducted output power. Table 5 details the results of these measurements. Plots showing conducted measurements made are depicted in Figure 7.

Table 5: Radiated Power Results.

Frequency Range	**Det**	**IF Bandwidth**	**Video Bandwidth**		
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	12-Apr-15
f > 1 000 MHz	Pk/Avg	3 MHz	3 MHz	**Test Engineer:**	Joseph Brunett
				EUT:	Danlaw DL815
Equipment Used: HRN15001, RSFSV30001				**Meas. Distance:**	3m

FCC/IC

#	Mode	Channel	Freq. MHz	Ant. Used	Ant. Pol.	Pr (Pk)** (dBm)	Ka (dB/m)	Kg (dB)	EIRP (Pk) (dBm)	Pout* (Pk) (dBm)	Ant Gain (dBi)	EIRP (Avg) Limit (dBm)	Pass (dB)
1	GFSK	L	2402.0	Horn LS	H/V	-21.7	21.4	0.0	11.5	10.7	0.8	30.0	18.5
2		M	2441.0	Horn LS	H/V	-22.5	21.5	0.0	10.8	10.6	0.2	30.0	19.2
3		H	2480.0	Horn LS	H/V	-23.0	21.7	0.0	10.5	10.4	0.1	30.0	19.5
4	Pi/4DQPSK	L	2402.0	Horn LS	H/V	-21.9	21.4	0.0	11.3	10.6	0.7	30.0	18.7
5		M	2441.0	Horn LS	H/V	-22.2	21.5	0.0	11.1	10.6	0.6	30.0	18.9
6		H	2480.0	Horn LS	H/V	-22.3	21.7	0.0	11.2	10.4	0.8	30.0	18.8
7	8QPSK	L	2402.0	Horn LS	H/V	-20.9	21.4	0.0	**12.3**	**11.3**	1.0	30.0	**17.7**
8		M	2441.0	Horn LS	H/V	-21.3	21.5	0.0	12.0	11.3	0.7	30.0	18.0
9		H	2480.0	Horn LS	H/V	-22.0	21.7	0.0	11.5	11.2	0.3	30.0	18.5
10	LE	L	2402.0	Horn LS	H/V	-21.7	21.4	0.0	11.5	10.5	1.0	30.0	18.5
11		M	2441.0	Horn LS	H/V	-22.5	21.5	0.0	10.8	10.5	0.4	30.0	19.2
12		H	2480.0	Horn LS	H/V	-23.2	21.7	0.0	10.3	10.3	0.0	30.0	19.7
13													

#	Mode	Channel	Freq. MHz	Supply Voltage	Ant. Pol.	Pr ** dBm	Ka dB/m	Kg dB	EIRP (Pk) dBm				
11	CW	M	2441.0	18.0	H/V	-21.8	21.5	0.0	11.5				
12			2441.0	15.0	H/V	-21.7	21.5	0.0	11.6				
13			2441.0	12.0	H/V	-21.7	21.5	0.0	11.6				
14			2441.0	9.0	H/V	-21.6	21.5	0.0	11.7				
15													

* Measured conducted from the radio using conducted test sample.

** Measured radiated at 3 meter distance. Peak power observed in test mode CW modulation.

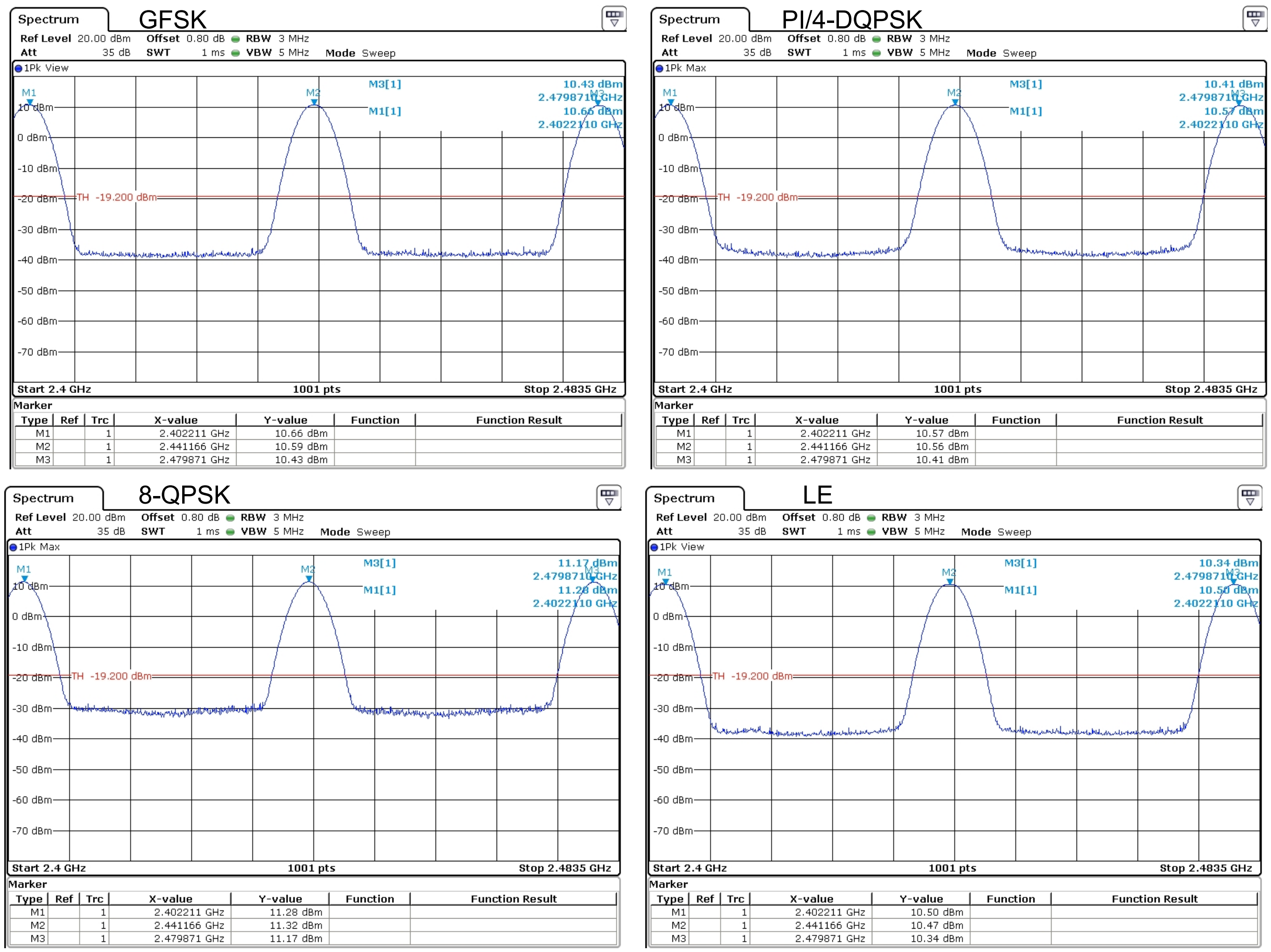


Figure 7: Conducted RF Power Plots

3.2.4 Power Spectral Density

For this test, the EUT was attached directly to the test receiver. Following FCC DTS measurement procedures, the emission spectrum is first scanned for maximum spectral peaks, the span and receiver bandwidth are then reduced until the power spectral density is measured in the prescribed receiver bandwidth. The results of this testing are summarized in Table 6. Plots showing how these measurements were made are depicted in Figure 8.

Table 6: Power Spectral Density Results.

Frequency Range	Detector	IF Bandwidth	Video Bandwidth		
2400-2483.5	Pk	3 kHz	10 kHz	**Test Date:**	6-May-15
				Test Engineer:	Joseph Brunett
				EUT:	Danlaw DL815
	Equipment Used: RSFSV30001			**Meas. Distance:**	Conducted

						FCC/IC
Mode	Channel	Frequency (MHz)	Ant. Used	PSDcond (meas)* (dBm/3kHz)	PSD Limit (dBm/3kHz)	Pass By (dB)
Continuous Tx. GFSK	L	2402.0	Cond.	6.0	8.00	2.0
	M	2441.0	Cond.	5.7	8.00	2.3
	H	2480.0	Cond.	6.0	8.00	2.0
Continuous Tx. PI/4-DQPSK	L	2402.0	Cond.	-5.8	8.00	13.8
	M	2441.0	Cond.	-5.6	8.00	13.6
	H	2480.0	Cond.	-6.6	8.00	14.6
Continuous Tx. 8-DPSK	L	2402.0	Cond.	-5.7	8.00	13.7
	M	2441.0	Cond.	-5.8	8.00	13.8
	H	2480.0	Cond.	-6.9	8.00	14.9
Continuous Tx. LE	L	2402.0	Cond.	-1.4	8.00	9.4
	M	2441.0	Cond.	-1.7	8.00	9.7
	H	2480.0	Cond.	-1.6	8.00	9.6

* PSD measured conducted out the the EUT antenna port following FCC DTS PKPSD procedure.

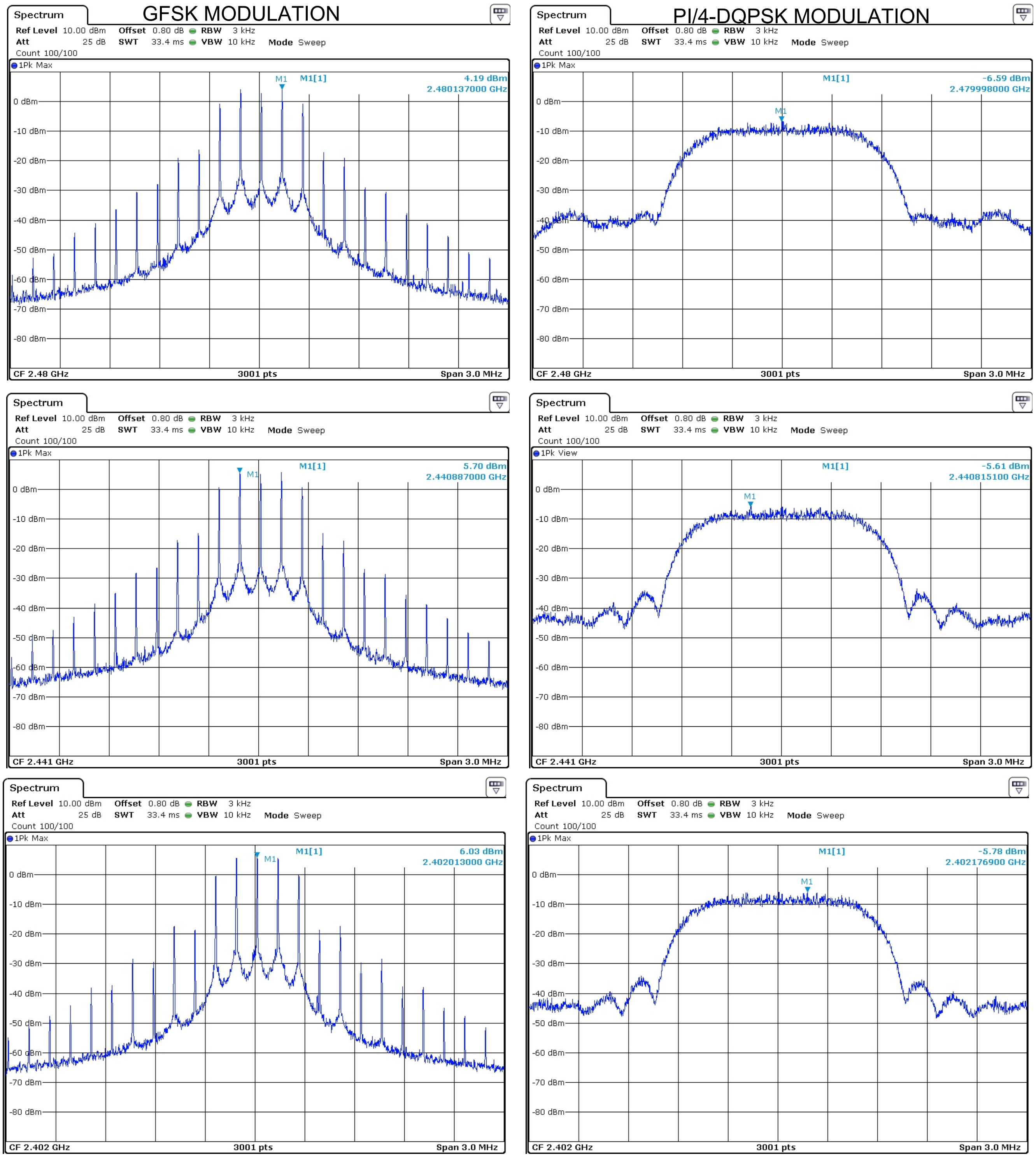


Figure 8(a): Power Spectral Density Plots.

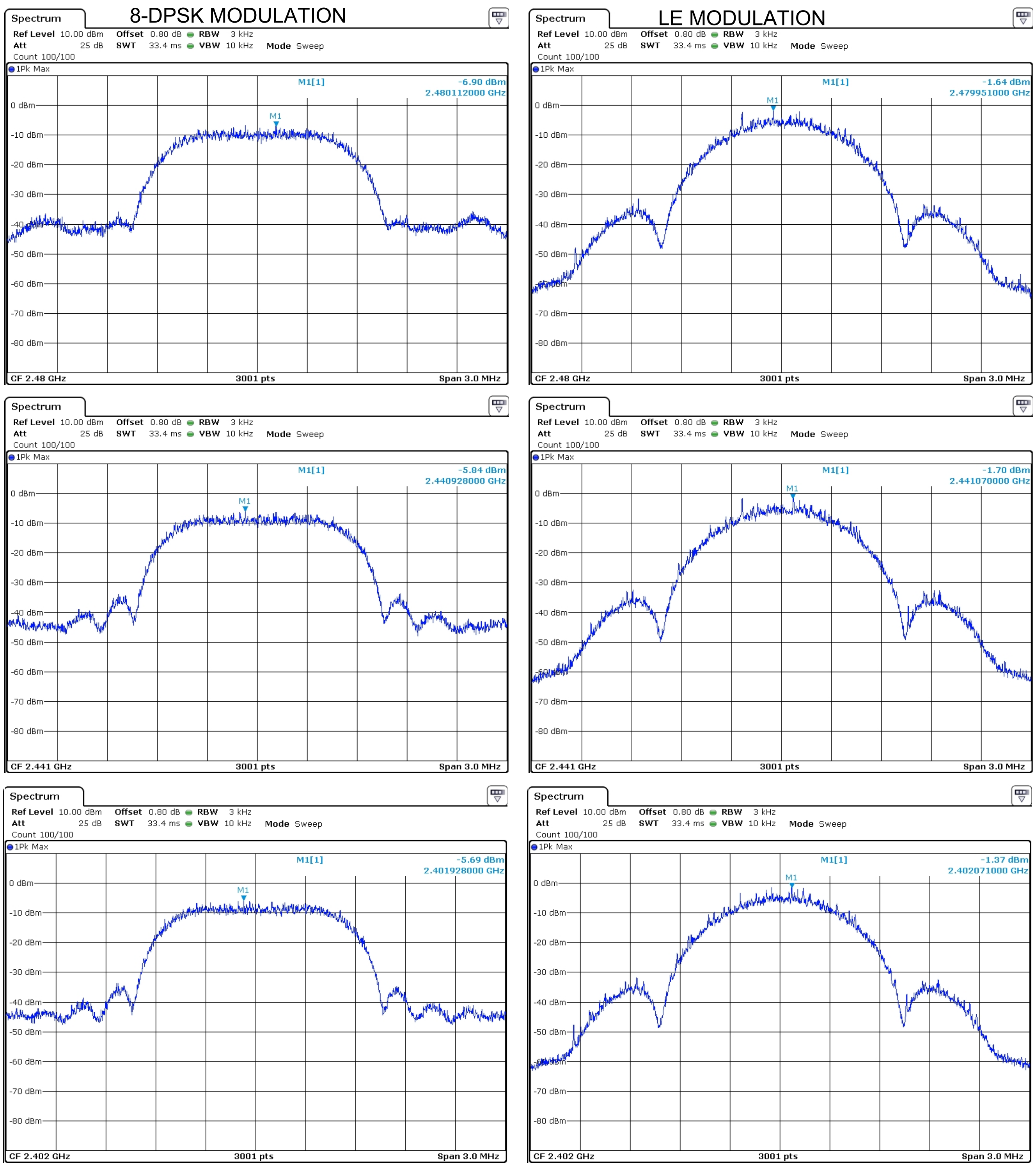


Figure 8(b): Power Spectral Density Plots.

3.3 Unintentional Emissions

3.3.1 Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions at the nominal voltage and temperature are provided in Table 7. Measurements are performed to 10 times the highest fundamental operating frequency.

Table 7: Transmit Chain Spurious Emissions.

Frequency Range	Det	IF Bandwidth	Video Bandwidth		
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	12-Apr-15
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz	**Test Engineer:**	Joseph Brunett
				EUT:	Danlaw DL815
				Mode:	Modulated (all modes)

Equipment Used: HRN15001, HRNC001, HRNXN001, HRXB001, HRNKU001, HRNK001, RSFSV30001 **Meas. Distance:** 3m

FCC/IC

#	Freq. Start MHz	Freq. Stop MHz	Ant. Used	Ant. Pol.	Pr (Pk) dBm	Pr (Avg)* dBm	Ka dB/m	Kg dB	E3(Pk) dBμV/m	E3(Avg) dBμV/m	E3 Avg Lim dBμV/m	Pass dB	Comments
1	Fundamental Restricted Band Edge (Low Side)												
2	2390.0	2390.0	Horn LS	H/V	-76.2	-91.6	21.3	-0.4	52.5	37.1	54.0	16.9	all channels; max all modulations; noise
3	Fundamental Restricted Band Edge (High Side)												
4	2483.5	2483.5	Horn LS	H/V	-75.6	-88.9	21.8	-0.4	53.6	40.3	54.0	13.7	all channels; max all modulations; noise
5	Harmonic / Spurious Emissions												
6	4804.0	4804.0	Horn C	H/V	-79.8	-86.2	24.6	-0.8	52.6	46.2	54.0	7.8	
7	4882.0	4805.0	Horn C	H/V	-75.2	-81.3	24.6	-0.8	57.2	51.1	54.0	2.9	
8	4960.0	4806.0	Horn C	H/V	-74.5	-80.8	24.6	-0.8	57.9	51.6	54.0	2.4	
9	4000.0	6000.0	Horn C	H/V	-74.5	-80.8	24.9	-0.8	58.2	51.9	54.0	**2.1**	all channels; max all modulations
10	7206.0	7206.0	Horn XN	H/V	-80.7	-91.2	25.1	-1.2	52.6	42.1	54.0	11.9	
11	7323.0	7323.0	Horn XN	H/V	-75.8	-83.8	25.2	-1.2	57.6	49.6	54.0	4.4	
12	7440.0	7440.0	Horn XN	H/V	-79.3	-86.9	25.3	-1.2	54.2	46.6	54.0	7.4	
13	6000.0	8400.0	Horn XN	H/V	-75.8	-83.8	27.1	-1.2	59.5	51.5	54.0	2.5	
14	8400.0	12500.0	Horn X	H/V	-95.2	-100.8	32.0	-2.0	45.8	40.2	54.0	13.8	all channels; max all modulations; noise
15	12500.0	18000.0	Horn Ku	H/V	-95.1	-102.7	35.4	-3.1	50.4	42.8	54.0	11.2	all channels; max all modulations; noise
16	18000.0	26000.0	Horn K	H/V	-93.8	-102.9	33.6	-3.9	50.7	41.6	54.0	12.4	all channels; max all modulations; noise
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													

*Avg measurements made employing RMS average detector.

3.3.2 Relative Transmit Chain Spurious Emissions

The results for the measurement of transmit chain spurious emissions relative to the fundamental in a 100 kHz receiver bandwidth (at the nominal voltage and temperature) are provided in Figure 9 below.

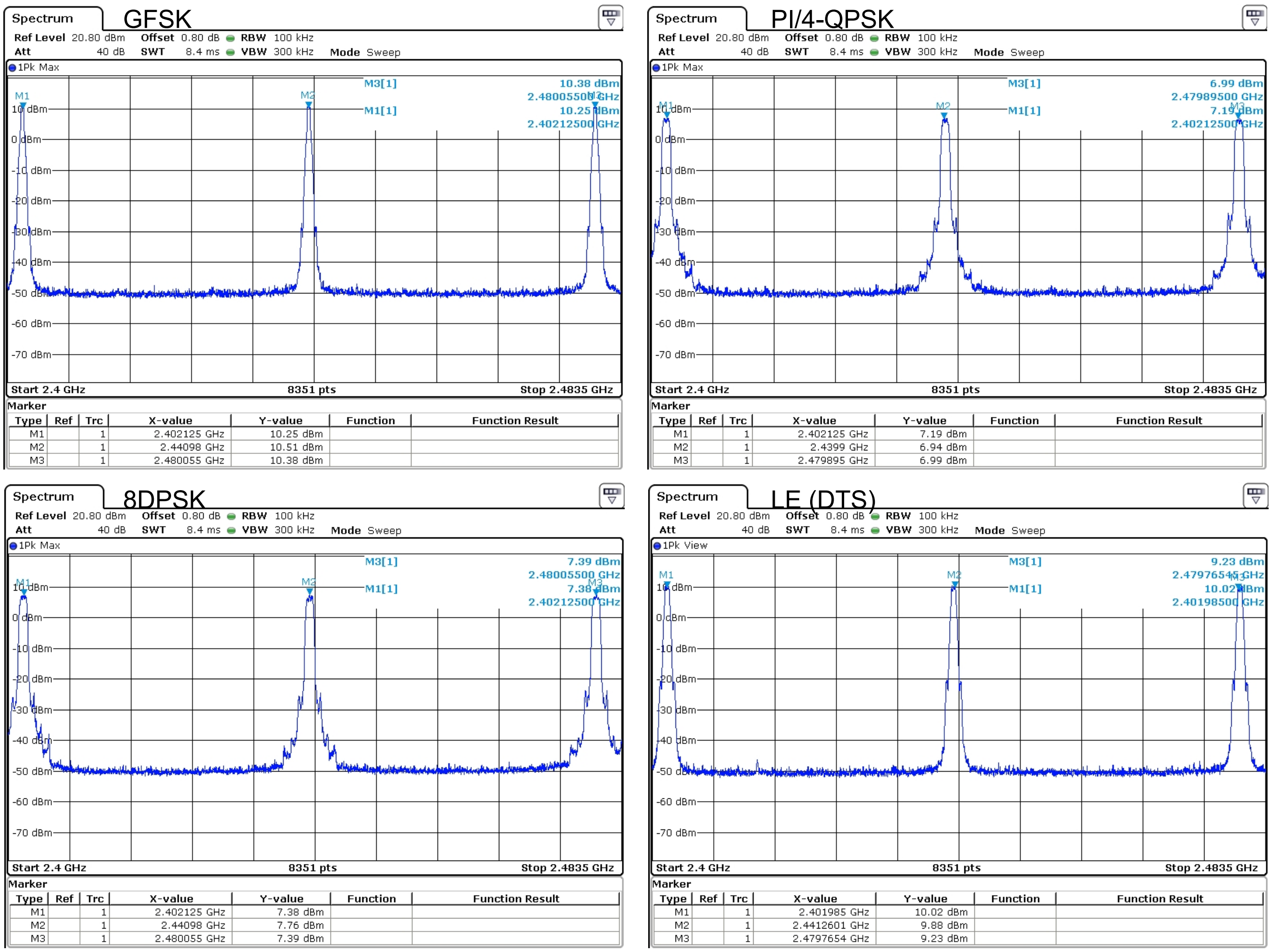
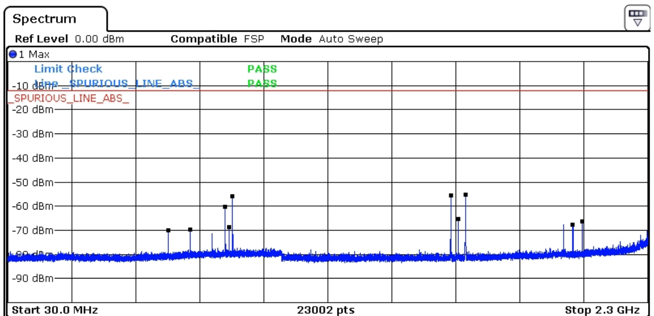
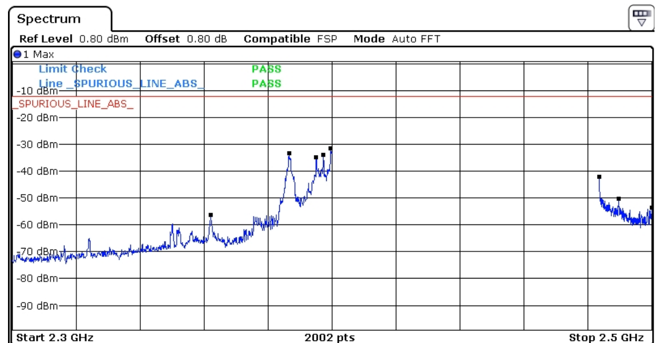


Figure 9(a): Conducted Transmitter Emissions Measured.



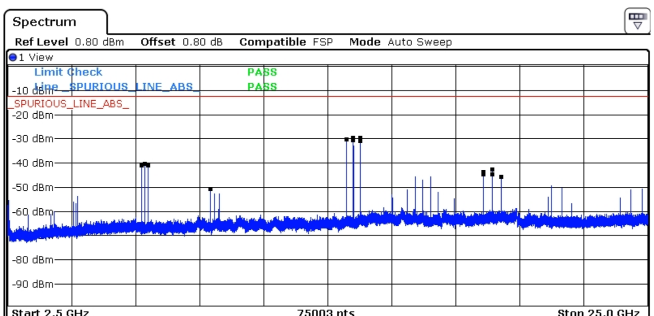
Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
30.000 MHz	1.000 GHz	100.000 kHz	826.72683 MHz	-55.89 dBm	-43.69 dB
30.000 MHz	1.000 GHz	100.000 kHz	800.73343 MHz	-60.37 dBm	-48.17 dB
30.000 MHz	1.000 GHz	100.000 kHz	813.73013 MHz	-68.60 dBm	-56.40 dB
30.000 MHz	1.000 GHz	100.000 kHz	677.45875 MHz	-69.55 dBm	-57.35 dB
30.000 MHz	1.000 GHz	100.000 kHz	599.38156 MHz	-70.03 dBm	-57.83 dB
1.000 GHz	2.300 GHz	100.000 kHz	1.65330 GHz	-55.34 dBm	-43.14 dB
1.000 GHz	2.300 GHz	100.000 kHz	1.60130 GHz	-55.43 dBm	-43.23 dB
1.000 GHz	2.300 GHz	100.000 kHz	1.62740 GHz	-65.38 dBm	-53.18 dB
1.000 GHz	2.300 GHz	100.000 kHz	2.06677 GHz	-66.17 dBm	-53.97 dB
1.000 GHz	2.300 GHz	100.000 kHz	2.03407 GHz	-67.73 dBm	-55.53 dB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
2.300 GHz	2.400 GHz	100.000 kHz	2.39955 GHz	-31.63 dBm	-19.43 dB
2.300 GHz	2.400 GHz	100.000 kHz	2.38646 GHz	-33.24 dBm	-21.04 dB
2.300 GHz	2.400 GHz	100.000 kHz	2.39725 GHz	-34.04 dBm	-21.84 dB
2.300 GHz	2.400 GHz	100.000 kHz	2.39505 GHz	-34.72 dBm	-22.52 dB
2.300 GHz	2.400 GHz	100.000 kHz	2.36209 GHz	-56.17 dBm	-43.97 dB
2.484 GHz	2.500 GHz	100.000 kHz	2.48351 GHz	-41.99 dBm	-29.79 dB
2.484 GHz	2.500 GHz	100.000 kHz	2.48956 GHz	-50.32 dBm	-38.12 dB
2.484 GHz	2.500 GHz	100.000 kHz	2.49999 GHz	-53.71 dBm	-41.51 dB



Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
2.500 GHz	10.000 GHz	100.000 kHz	7.32366 GHz	-40.13 dBm	-27.93 dB
2.500 GHz	10.000 GHz	100.000 kHz	7.44065 GHz	-40.89 dBm	-28.69 dB
2.500 GHz	10.000 GHz	100.000 kHz	7.20666 GHz	-40.92 dBm	-28.72 dB
2.500 GHz	10.000 GHz	100.000 kHz	9.60747 GHz	-50.57 dBm	-38.37 dB
2.500 GHz	10.000 GHz	100.000 kHz	9.60867 GHz	-50.70 dBm	-38.50 dB
10.000 GHz	17.500 GHz	100.000 kHz	14.87915 GHz	-29.52 dBm	-17.32 dB
10.000 GHz	17.500 GHz	100.000 kHz	14.64696 GHz	-29.61 dBm	-17.41 dB
10.000 GHz	17.500 GHz	100.000 kHz	14.41057 GHz	-30.18 dBm	-17.98 dB
10.000 GHz	17.500 GHz	100.000 kHz	14.64516 GHz	-30.62 dBm	-18.42 dB
10.000 GHz	17.500 GHz	100.000 kHz	14.88095 GHz	-30.87 dBm	-18.67 dB

Conducted Relative Spurious Emissions
- All Modulations (Max Held)
- 20 dB down in 100 kHz IFBW

Figure 9(b): Conducted Transmitter Emissions Measured.

3.3.3 Radiated Receiver Spurious

The results for the measurement of radiated receiver spurious emissions (emissions from the receiver chain, e.g. LO or VCO) at the nominal voltage and temperature are reported in Table 8. Receive chain emissions are measured to 5 times the highest receive chain frequency observed, or 4 GHz, whichever is higher. If no emissions are detected, only those noise floor emissions at the LO/VCO frequency are reported.

Table 8: Receiver Chain Spurious Emissions ≥ 30 MHz.

Frequency Range	**Det**	**IF Bandwidth**	**Video Bandwidth**		
25 MHz ≤ f ≤ 1 000 MHz	Pk/QPk	120 kHz	300 kHz	**Test Date:**	12-Apr-15
f > 1 000 MHz	Pk/Avg	1 MHz	3 MHz	**Test Engineer:**	Joseph Brunett
Equipment Used: HRN15001, RSFSV30001				**EUT:**	Danlaw DL815
				Meas. Distance:	3m

#	Freq. MHz	Ant. Used	Ant. Pol.	Pr (Pk) dBm	Pr (QPk/Avg) dBm*	Ka dB/m	Kg dB	E3(Pk) dBμV/m	E3(Avg) dBμV/m	FCC/IC E3lim dBμV/m	CE E3lim dBμV/m	Pass dB	Comments
													FCC/IC
1	2402.0	Horn LS	H/V					38.2		54.0		15.8	max all, noise
2	2441.0	Horn LS	H/V					38.7		54.0		**15.3**	max all, noise
3	2480.0	Horn LS	H/V					39.0		54.0		15.0	max all, noise
4													

*QPk detection below 1 GHz, Avg detection at or above 1 GHz with receiver bandwidth as specified at top of table.